TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

VOL. III NO. 11. NOVEMBER, 1926. PRICE 6d.

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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

Cables :: "Stomata." | Phone :: 1983.

TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed in signed articles are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

RISK IN AGRICULTURE.

IN a recent number of *Tropical Agriculture*, in an article headed "Fruit Report of the Imperial Economic Committee" September, 1926, p. 194, appeared the following statement. "In the poorest agricultural tracts with which I am acquainted, those of Bandelkhand in India, the common practice is to sow wheat, barley, mustard, linseed, gram and perhaps other peas in one field. The basis of this practice in a country of precarious conditions is insurance by a population unable to carry the risks of a single crop." The statement appears to have attracted some attention and we propose to develop the idea a little further.

In nature, competition regulates the phanerogamic flora. Those species best adapted to the ecological conditions persist, and the usual, though not invariable, result, is a mixed growth. A similar competition regulates the fauna and cryptogamic flora, and it is one of the surprises that nature has in store that such competition leads to specialisation; particular insects feed on, and particular fungi infect, particular plants. Why this should be so and why, what appears at first sight a definite restrictive influence, should be the rule, we do not here attempt to explain; it is a fact we recognise. Accepting that, it is not hard to see that a single plant of a species growing in a community of other species, gains a certain degree of immunity from the very fact of its isolation. Cultivation consists in the aggregation of plants of the same species into one locality, the field or garden, to the partial elimination of other species. The very fact of contiguity necessarily adds to the risk of attack or infection. But this is not the sole result of cultivation; what are practically pure cultures of plants are found in nature and survive as such, and the contiguity given by cultivation would not alone raise an undue risk. Cultivation involves something further. A plant is cultivated for some product of economic value, and from earliest times man has exercised, more and more consciously as time progressed, a selective influence in favour of those plants yielding the most valuable form, or the largest volume, of that product. This is a very different selective force from that exercised in nature. Immunity to particular disease usually bears no relation to economic desirability: and it is very often the case that cultivated plants are the more susceptible.

Again, though there exists for each species, and for each variety, of plant, an optimum condition of soil and climate, few are so restricted in their

likes that they will not grow under a considerable diversity of conditions. The removal of competition which cultivation implies, therefore, enables a crop to be grown under conditions which are not optimal and under which the plant in question could not exist, in a state of nature. The limits of cultivation are now imposed not by any ecological condition but by a minimum economic yield. Lastly we have the question of the variability of climatic conditions between successive crop seasons. Good seasons alternate with bad and crops vary from season to season. In both these cases the crop is growing under conditions which are likely to render it more susceptible.

Cultivation, therefore, involves risk which requires capital for the protection of the cultivator and the risk is proportionate to the similarity of the units forming the crop. In the case instanced in the article under reference the cultivator has practically no capital to fall back on; he is dependent on the production from his field for his food supply from crop to crop, and in the event of failure he can only have recourse to the money lender. He, therefore, sows a large mixture of plants; if moisture is short he will obtain his return from his barley; if it is abundant his wheat and mustard will give him his return; if it is excessive and his wheat destroyed by rust his peas will yield his requirements. In no case is the yield large but it averages out and, more important, complete failure is practically avoided. Here the cultivator has, unconsciously no doubt, adopted a system of insurance suited to his economic condition.

A further interesting stage in the process of specialization is shown in the wealthier tract of the Ganges Valley. Here the economic condition of the cultivator is such that he will grow a pure crop of wheat, interspersed possibly with mustard to provide his oil requirements. That wheat crop, however, will be found to contain a large number of varieties, and it is hardly too much to say that wherever the sample be taken along the belt of some 600 miles, the same varieties will be found. What does differ is the proportion in which the different varieties occur in the field. Climatic conditions, in the absence of guided selection, bring that variety to the fore which is particularly adapted to the local conditions. A series of abnormal seasons is here quite capable of markedly altering the proportions of the different varieties in the crop of any one place.

The same is true of most of the crops of the plains of India; they are mixtures of varieties subject only to such variation as climatic conditions impose. Recent developments have introduced pure races of wheat, cotton and other plants but this must inevitably add to the risk.

The risk is increased enormously when we turn to the question of plantations and gardens. Plantations and gardens are names usually applied to perennial crops such as Tea, Cacao, Rubber, Coconut and such like. A large area planted under one of these affords optimal conditions for the spread of disease and the risk may be gauged by the effect of Hemileia which wiped out Coffee in Ceylon in the seventies of last century. Observation and skilled advice form the best insurance in such cases. Hitherto little has been done in the direction of varietal selection among such plants, but work on these lines is under weigh. The divergence of yield of different rubber trees is known, and selection of high yielding plants for propagation is already undertaken. The process with a perennial plant, is slow, but it has to be recognised that such selection must add to risk.

Lastly there are the cases of such plants as the sugar-cane and banana. These are propagated vegetatively and, though the origin of the earlier varieties of canes and of bananas is not known, in the latter case, the variety is definitely a single individual propagated by subdivision until many hundreds of acres are covered. In such a crop the risk is at a maximum. Should a disease appear it may run through a whole country side wiping out the crop. This is what has happened in large tracts where the banana used to be grown but which, owing to Panama disease, have now gone out of cultivation. Protection in such cases is only to be secured by regularised work on the particular crop. In the case of cane, it has been ascertained that seedlings can be readily raised and the work started by Harrison and Bovell in Barbados has been expanded both in the West Indies and in such places as Coimbatore in India, until, now, a regular stream of new forms is being tried out ready for such an emergency as that indicated. The possibility of securing Bananas from seed has only been appreciated at a more recent date.

These are the ultimate lines on which a remedy has to be sought. Much, however, can be done to mitigate and delay an attack. Any system of agriculture which is dependent on a single crop is unsound. At least one alternative crop is desirable, or, if this be not possible, a system of intensive cropping which will enable a reasonable portion of the area to be left fallow or under cover crop is desirable. By this means it should be possible to adopt a system of striping, that is, growing the crop in blocks or strips isolated from each other. By such means is obtainable a control over disease, when it appears, which is impossible in any extended and continuous area.

A gratuitous specimen copy of *Tropical Agriculture* will be sent, post free, to any member of an agricultural society or to any other individual interested in tropical development on application to the Editor, *Tropical Agriculture*, The Imperial College of Tropical Agriculture, St. Augustine, Trinidad, B.W.I.

RUBBER IN AFRICA.

THE United States Department of Commerce has recently published a report on "Rubber Production in Africa" written by H. N. Whitford and Alfred Anthony of the crude rubber section, rubber division. This is the fifth of a series of publications on crude rubber issued under authority of the Sixty-seventh Congress, which appropriated funds for the investigation of raw materials wholly or largely under foreign control.

Up to 1912, Africa stood second to South America in the amount of rubber supplied for world consumption. The continent reached its maximum in the year 1926 with shipments amounting to over 20,000 tons. Again in 1910 it produced this amount, but since then there has been a gradual reduction until in 1922 about 2,500 tons were exported. The total African production was contributed by some 25 different political units.

While the main cause for the decrease in the shipments of rubber from Africa has been the drop in prices, there are other contributing factors. There was a considerable decline in the amount of rubber exported even before rubber prices fell to any great extent; in 1913 the total shipments amounted to 16,000 tons, and the 1914 shipments decreased to less than one-half of this, the lowest figure recorded up to that time. This was due mainly to the World War and its effect on Africa, chiefly in the former German colonies, which previously had contributed considerable quantities of rubber to the world's markets. The war influenced the production of rubber in other colonies also. In some of these, notably Madagascar, the collection of rubber was largely fostered by German traders. After 1914 the annual production of rubber in Madagascar fell below 100 tons. Even before 1914 the fluctuation in the annual production of African rubber shows, generally speaking, that the fall in price below a certain limit affected the amounts of rubber shipped.

While in nearly all the political units of Equatorial Africa the rights of the natives are carefully guarded, there are large areas of suitable rubber land than can be obtained for plantation projects where there is no conflict with such rights. In the Belgian Congo large concessions have been obtained on reasonable terms by special arrangements approved by the Belgian Parliament. In the British West African colonies concessions are granted with restrictions that protect both the forests and the rights of the natives. The colonial governments generally encourage investments. In Uganda leases for periods not exceeding 99 years are granted by private treaty; the rent per acre varies with the duration of the lease. Requirements for the leasing of land in the French colonies are not uniform. In Liberia land leases can be obtained for long periods and covering large areas with the consent of the Liberian Congress.

The total area of the countries considered herein exceeds 7,000,000 square miles; total population (estimated), 78,000,000.

Nearly all the countries of Africa where Hevea might be produced have comparatively large indigenous populations. The problem of mobilizing this labour for steady plantation work has been a difficult one and is perhaps the chief drawback to agricultural development of any sort on a large scale. As a rule, the basic agricultural wage ranges from the equivalent of 10 cents to 30 cents United States currency per day. The days of enforced labour by indenture or by imposing a heavy head tax so that the native will have to work to pay such a tax are past. Persuading the native to work has generally taken the place of compulsion. Where compulsion was practised, the native has not forgotten the white man's efforts to make him work, hence in such regions he is not easily persuaded. His rights in this respect are generally rigidly protected by the Government authorities. If he works at all, he prefers to work on his own farm. The Governments in some instances have taken advantage of this trait and have encouraged him to plant commercial crops of his own with the others that are needed to supply him with food.

Up to about 1910 practically all of the rubber that was gathered in Africa came from wild plants. Since 1912 a very small proportion of the rubber has come from planted trees. Especially in 1923 and 1924 the quantities of rubber from plantations considerably increased, although the exact amount can not be determined because cultivated rubber is not always separated from wild in the statistics.

The plants that have contributed most to the African shipments of rubber belong to the family Apocynaceae (dogbane). The principal tree in this family that is a source of rubber is *Funtumia elastica*, which is confined to that portion of the equatorial belt stretching from the Gulf of Guinea to about the longitude of Lake Victoria in the Uganda Protectorate. This tree grows in both the tropical and the partly tropical evergreen hardwood forest; in some districts it seems to be more abundant in the latter than in the former.

As far as can be determined, however, larger quantities of rubber have been gathered from various vines and so-called shrubs that belong mainly to the genus Landolphia and other closely related genera, such as Clitandra and Carpodinus. The species of these genera have a much wider distribution than *Funtumia elastica;* in fact, they are found in all the vegetative types described above. The genus Mascarenhasis is represented by several species of trees from which small quantities of rubber have been gathered. This genus is confined to West African colonies and to Madagascar.

Numerous other species of plants have contributed small quantities of rubber to the markets. Among these may be mentioned Ficus (Moraceae or fig family), Euphorbia (Euphorbiacae or Para rubber family), and Cryptostegia (Asclepidaceae or milkweed family).

Practically all the wild plants from which rubber is gathered in Africa are of such a nature that the cheapest method of collecting the latex

is to destroy the plants. This applies to trees as well as to vines. Most of the rubber offered is in a very crude form, inasmuch as it has been poorly prepared. It generally contains a considerable quantity of moisture and foreign substances and sometimes has deteriorated badly before it reaches the market. In many instances, too, it is mixed with the latex of inferior species, which further lowers its market value.

The governments of the various political units of Africa have appreciated the fact that the destructive collection methods in use would eventually deplete the forests of rubber-producing plants. Practically all of them sooner or later passed laws prohibiting the collection of latex by the destruction of the plants. In most instances, however, much of the rubber was gathered in outlying districts over large areas, and it was impossible to enforce these regulations. In the few cases where the natives were subject to control there was a noticeable decrease in the amount of rubber produced. This was due primarily to the fact that gathering latex by tapping the standing plants instead of cutting them down before extracting the latex proved to be very expensive and consequently did not pay.

As stated above, the first marked decrease in the production of rubber in Africa occurred in 1914. In 1916 and 1917 production increased slightly, reaching 10,000 tons. From that time on there has been a gradual decrease. Although the price in 1919 was sufficiently high to induce the collection of more rubber than is indicated by the production of this year, failure to do so was probably due to the fact that there had not been sufficient time to recognise the war-disrupted collecting agencies before the price of rubber dropped to an unremunerative figure.

It is quite probable that should the price of rubber remain at a fairly high level for a considerable number of years there will be a re-organization of the collection industries in various parts of Africa, but it is doubtful if production of wild rubber in that continent will ever again reach the figures it has in the past although the provision of better transportation facilities in various districts may open up regions in which rubber gatherers have not worked heretofore. Many of the old regions have been well-nigh depleted of their rubber-producing plants by destructive collection methods. In some instances, however, where a number of years have elapsed since they were previously worked over, new plants may have had time to replace, in part at least, the old ones that were destroyed. However, these regions may not produce as much rubber as they formerly did.

Certain of the colonies that heretofore have depended on rubber production have encouraged the planting of crops of various kinds under the control of both Europeans and natives, which require a great deal of the labour force that was formerly used in collecting rubber. In such regions it is doubtful whether there will be much labour available for rubber collection.

In the first decade of the present century colonial officials and commercial companies in nearly all sections of tropical Africa encouraged the planting of rubber, the former by establishing experimental plantings and in some instances by urging the natives to plant. Practically all the wild species that were producing commercial quantities of rubber were tried—Manihot (Ceara or manicobo), Castilla (caucho or Castilloa), *Funtumia elastica* (lagos silk rubber tree), Landolphia (vine rubber), *Ficus elastica* (Rambong), Hevea brasiliensis (Para), and others of less importance. In Africa, as elsewhere, efforts to make a commercial success of all these species have been practically abandoned in favour of Para rubber.

German East Africa (now Tanganyika Territory) stood first in acreage devoted to rubber. In 1912 over 113,000 acres had been planted, all but 1,000 acres of which was Ceara rubber. While more than 1,000 tons, mainly Ceara were exported in both 1912 and 1913, it is stated that in 1914 the German planters had begun to replace marginal areas devoted to Ceara with other crops, since the cost of tapping such areas was so high that profitable returns could not be obtained. At the outbreak of the war these plantations were entirely abandoned.

Such statistics as are available concerning the acreage planted to Hevea in Africa are generally misleading for various reasons. In the first place, this rubber has largely been planted with other crops, principally coffee and cacao, and to some extent with other rubber species such as Funtumia and Castilloa. In some instances only the number of trees is recorded, in others the acreage, and sometimes these two methods of recording seems to overlap. Moreover, in some cases statistics of acreage or number of trees planted can be obtained only for years previous to 1915, and, since disturbances due to the war caused entire abandonment of some planted areas, it remains to be determined the acreage that might be salvaged and brought into bearing.

However, from the data at hand it is roughly estimated that there is the equivalent of upward 38,000 acres of planted Hevea in Africa to-day, distributed as follows:—

	acres.
Uganda	16,000
Belgian Congo	5,000
Nigeria	8,000
Gold Coast	800
Cameroons (British)	7,000
Liberia	1,400
Total	38,200

This rubber can be classed as mature, inasmuch as, except for small acreages in Uganda, practically no planting has been done since 1914. It is impossible to state how much plantation rubber has been produced, since statistics do not always separate the plantation product from the wild.

(To be Continued.)

QUEENSLAND COTTON.

Ratooning.

MR. G. EVANS, C.I.E., M.A., Director of Cotton Culture, Queensland, writing on "the Future of Cotton Growing in Queensland" in the *Empire Cotton Growing Review*, states that "The unfortunate controversy about ratooning was really based on a misconception. Certain of the self-styled "cotton experts" that swarmed in Queensland, and included men from every walk of life whose chief distinction seems to have been a lamentable lack of knowledge of cotton-growing, spread the notion abroad that cotton if ratooned was drought resistant, did not suffer from pests, and required the minimum amount of work. This naturally sounded most attractive to that class of grower who, not being previously an agriculturist, was led to believe that he was going to "get rich quick" by growing cotton. When I arrived in the country, a Bill prohibiting the ratooning of cotton had already been drafted by the State Government, largely as a result of a visit by a cotton-growing delegation headed by Mr. Crompton Wood, which had just left. The Premier had also announced that no more ratooning would be allowed after the 1922 season came to an end.

The terrific outcry that followed when this Bill was passed by Parliament is recent history. It is sufficient to say that the Local Government found it politic to repeal the Act within a few months of it becoming law. The damage that has been done is considerable, and the industry will take some time to recover from it. As a result of repealing the Act, the majority of the cotton-growers ratooned a portion of their crop. The wise ones only ratooned a small portion, others ratooned the whole and planted no fresh seed. The result has been interesting in that the wet spring prevented the proper cultivation of the ratoon cotton owing to its spreading of growth, except on very small areas where the crop could be worked by the hoe, but only at an excessive cost. The sequel has been that large areas of ratoon cotton have been beaten by the weeds and summer grass, and are now lying abandoned. It is not difficult to imagine that if the labour that had been put into ratooning had been devoted to increasing the area under plant cotton which this year has probably yielded nearly twice as much per acre as the ratoon, our crop this year would have been about fifty per cent. greater and the quality immensely superior. As it is, this season's crop will probably be about 11,000 bales.

This year's experience has at any rate convinced the growers that ratooning is not such an easy matter as they were led to believe. Experience has shown that a ratooned crop needs to be cultivated just as carefully as plant cotton if a decent yield is to be obtained, and that if this is done it actually costs more to bring the crop to harvest. The ratoon cotton, curiously enough, suffered more in the dry spell of December and during the February heat wave than the annual, as has been proved by boll counts, and also suffered from pests, as Mr. Ballard in a recent report has proved. The relative failure of the ratoon crop may have caused a few men to abandon their holdings in the Rockhampton and Dawson Valley areas. It is mostly those, however, who are not acquainted with farming methods who have gone. The whole controversy, unfortunate as it has been in many ways, has, at any rate, brought one fact to the front, and that is that cotton requires just as careful farming as other crops, and that the old cursory methods formerly advocated are not practicable. Personally, I am convinced that the practice of ratooning will gradually die out over the greater part of Queensland. In the scrub areas, where newly felled blocks are being burnt and brought into cultivation, it may persist, but the pink boll worm and higher picking costs will, I think, render it unprofitable. On ploughed land and forest country generally, I believe that the method of planting fresh seed each year will prevail, more especially when cotton is bought on quality in accordance with its actual merits and not merely on a Government guarantee. On certain classes of soil and in certain of the drier inland belts ratooning may persist here and there, but it is bound to act as a "carry-over" for pests, and the amount produced is not likely to be large. I do not see how it will be possible for ratoon cotton in Queensland to be grown on a large scale under existing economic conditions."

THE USE OF THE AEROPLANE FOR APPLYING INSECTICIDES.

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THE use of the aeroplane for the application of insecticides by means of dusting is the newest method of combating injurious insects. The following article is written with the object of tracing the development of this venture and summarising its position at the present day. During the spring of 1925, the writer visited the Delta Laboratory, for cotton boll weevil investigations, at Tallulah, Louisiana. While there he had the pleasure of discussing some of the technical problems with Dr. B. R. Coad, who is in charge, as well as witnessing a demonstration flight in the use of the aeroplane for dusting purposes. A journey of about 45 miles was also taken in an aeroplane over territory where dusting operations had been carried out on a moderately large scale.

The possibility of applying insecticides by means of aeroplanes was first investigated in August, 1921, when the Ohio State Experiment Station conducted a series of trials with lead arsenate. The tests consisted in distributing the

poison from an aeroplane over a grove of catalpa trees which were being defoliated by the larvae of the catalpa sphinx moth (*Ceratomia catalpae* Bdv.), and the success achieved in this experiment suggested the use of the aeroplane to combat the cotton boll weevil (*Anthonomus grandis* Boh.). At the request of Dr. B. R. Coad, arrangements were made by the U. S. Department of Agriculture for a series of trials to be carried out the following year at the Delta Laboratory, Tallulah, La. Since the cotton leaf worm (*Alabama argillacea* Hübn) was, at the time of the experiments, causing severe damage in the vicinity of Tallulah this insect was made the subject of these trials. It was also apparent that the effects of the treatment on a leaf-feeding insect would be more immediate and easier to estimate for purposes of a preliminary trial than on the cotton boll weevil. In these experiments calcium arsenate was used and the results achieved showed that the cotton leaf worm could be controlled with a poison allowance considerably below that necessary when using ordinary dusting machines on the ground. During 1923 boll weevil control with aeroplanes was undertaken on two entire plantations covering about 3,000 acres. The net result of the experiment showed that the aeroplane can distribute an insecticide efficiently, effectively and profitably for the control of the cotton boll weevil. During 1925, over 50,000 acres of cotton were dusted commercially, and plans are in preparation for a more extended application of dusting from aeroplanes in the future. While this method is naturally undergoing development and modifications in technique, its advantages have now definitely passed the preliminary experimental stage. It is noteworthy that spruce, pecan, tobacco, peaches and citrus fruits, in addition to catalpa and cotton, have been dusted from the air. Experiments also in poisoning *Anopheles* larvae with paris green delivered from aeroplanes, in the lakes and bayous of Louisiana, have reached a point when appropriations are being considered with the object of adopting this method for extensive control. The same method has been tested with reference to the control of mosquito larvae in flooded rice fields which proved well adapted for successful treatment by aeroplane.

In so far as cotton dusting is concerned, the aeroplanes fly from 10 to 20 feet above the growing crop and at a speed of 60 to 80 or more miles per hour. Under ordinary conditions it is not necessary to distribute more than 2 to 3 lb. of the arsenical per acre in order to obtain satisfactory weevil control. At first, military aeroplanes were used for this work, but were found unsuitable. Under average conditions two methods of flying need to be adopted: the long straight-away flights over extensive fields, and the short flights involving quick turns which are required in restricted areas. Aeroplane builders turned their attention to the subject and the outcome of experimental work has been the production of special planes which are safer and more efficient for dusting purposes than are military machines. The Huff-Daland Model 5 is a new machine and is recommended by the U. S. Department of Agriculture for the small-field type of work on account of its diminutive size, manoeuvring capacity and ease of control. It has a calcium arsenate capacity of 300 lb., carries fuel and oil for a four hours' flight, and is capable of dusting 300-400 acres per hour. The Huff-Daland Model 31 was designed and constructed to specification of the U. S. Department of Agriculture to meet the requirements of dusting large open areas. It has a calcium arsenate capacity of 1,000 lb. fuel and oil for four hours, and can dust 600-1,000 acres per hour. It is assumed that 80 per cent. of the average cotton fields can be dusted with Model 5, and, at an average of 360 acres per hour, a day's flight of four hours will be capable of treating 1,440 acres.

The advantages of aeroplane dusting are stated by Mr. G. B. Post, of the Georgia State College of Agriculture, to be as follows: (1) It saves 50 per cent. to 60 per cent. of the calcium arsenate required to produce the same results by any other method of dusting. (2) Unlike ground dusting it is not necessary that it should be carried out at night, and the usual dry winds are not a hindrance. (3) One aeroplane will carry out the work of 50-75 cart dusting machines, as the best cart machine, under favourable conditions, dusts about 30 acres *a day* compared with 200-1,000 acres *per hour* by a single aeroplane. (4) The possibilities of the aeroplane are limited only by its capacity for carrying fuel, oil and the dusting material. According to figures compiled by the Louisiana State University, May, 1924, the average cost of five dustings was $7.26 per acre (approximately £1 10s.) and the dusted fields yielded an average clear net gain of $33.14 per acre (approximately £6 16s. 6*d.*: at 11 cents per lb. of seed cotton) over fields that were not dusted.

Two chief types of hoppers have been designed, and for the discharge of the dust a valve is opened and the dust liberated either by means of a kind of paddle wheel worked by hand or by air suction. More recently various other devices for distributing the poison from the aeroplane have been developed and perfected.

One of the most remarkable results of aeroplane dusting is the large amount of poison which adheres to the plants over a very wide path, and even under atmospheric conditions which would be considered impossible for adherence to occur with the use of the best of existing ground dusting machines. This fact immediately demanded research since it indicated the possibility of all types of dusting taking place during daytime. It appears probable that a considerable portion of the observed effect is due to the positive electrical charging of particles of the dust and their coming in contact with the plants which carry a negative charge. The principles involved and their possible application to commercial operations are being investigated

in co-operation with the Bureau of public Roads and the Bureau of Standards.*

Finally it may be added that no farmer can afford to maintain aeroplanes and carry out his own dusting. In fact the operation can only be considered on a community basis or as one for large planters. The Huff-Daland Co., however, have established an aeroplane service, and are able to do the work at specific charges in certain districts where farmers most demand it.

The application of the aeroplane for forest pest control is now an accomplished fact in German forestry practice, and the subject has recently been reviewed by Wolff and Krausse (1925), who quote instances where it has been carried out. Krieg (1925) refers to a severe out break of the pine moth (*Panolis flammea*) in Germany in 1924, which was followed early in 1925 by an infestation of the nun moth (*Lymantria Monacha*). As this threatened to be of serious proportions, opportunity was taken to dust the infested area of forest with calcium arsenate discharged from aeroplanes. Flying at a height of 12 to 60 feet above the tops of the trees, an aeroplane dusted a strip about 80 to 120 yards wide. A forest of about 600 acres, composed of mixed trees required thirty-eight such strips and, in the case of spruce, the calcium arsenate expenditure amounted to about 26 lb. per acre. Since the nun moth larva is comparatively resistant to insecticides the expenditure of calcium arsenate could be reduced for other insect pests. Subsequent examinations showed that all the nun moth larvae were killed in five to six days, and it is stated that no injurious effects were observed on game or birds. The aeroplane has been used for forest scouting and patrol work in Canada and, after problems relative to expense and safety of operations have been solved, probably only a short period will elapse before it will be utilised for dusting purposes in that country also. In North and South Africa and other countries where locust invasions are prevalent, the aeroplane is destined to form the most formidable weapon for controlling these plagues. No other means can compete with it in such cases where prompt and energetic action is demanded at short notice and extensive areas of country are concerned. It may be added that large scale dusting experiments by the use of aeroplanes were carried out in Russian Turkestan in 1924 for the control of locusts. Korotkikh has recently given a brief account of a series of trials carried out in 1925 by the Russian Commissariat of Agriculture, in conjunction with the Air Force, in the extensive reed beds of the River Kuma in the Northern Caucasus. The experiments were directed against the European migratory locust, *Locusta migratoria* L., and the trials are stated to have been very satisfactory, about 2,700 acres being dusted. One aeroplane covered 270 acres in an hour, but, with technical improvements, it is considered that this figure is capable of considerable increase. The application of paris green or sodium arsenate as dusts compared favourably with spraying with about the same quantity of the toxic agent per acre. The method proved most effective against the " hopper " stage of the insect : dusting the resting swarms of adults was also possible but needed to be carried out in the early morning before such swarms became disturbed and dispersed. It is mentioned that the dusting operations were accompanied by certain poisoning effects upon the men employed, and the airmen had to wear respirators. These disadvantages are not reported in trials carried out in other countries, but it is not possible to say to what extent that may be avoidable under the conditions applicable to the Russian experiments.

In England there are comparatively few large areas devoted to single crop cultivation, and the possible application of the aeroplane is necessarily limited. Nevertheless, it seems likely that the method has chances of development in the future, particularly if inventions lead to the evolution of planes capable of landing and operating in limited areas. In 1924, fifty acres of fruit trees on a farm near Sevenoaks were dusted against caterpillar infestation. It has not been possible, however, to obtain reliable details with respect to the methods employed or the success of the venture.—*Journal of the Ministry of Agriculture*, June, 1926.

* New types of ground dusting machines have been constructed, with special reference to certain of the new principles brought to light through aeroplane operation. What promises to be one of the most efficient dusting machines so far evolved has passed through much of the experimental stage, and it is hoped that it will prove to be the first satisfactory day-light dusting machine. This would abolish the necessity of having the plants wet with dew, thereby eliminating night dusting as is required under present methods.

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CHEMICAL INDUSTRIES IN INDIA.

(*The following article is based on a review by Dr. H. E. Watson, of the Indian Institute of Science, Bangalore, India, which appeared in "Industrial and Engineering Chemistry," July, 1926, pages 748 to 752.*)

A CASUAL observer might easily conclude from the small number and size of the factories in India, that chemical industries are a negligible item in the country's economy. Whilst it is safe to say that 75 per cent. of the population would be quite unaffected if the newer, "imported" industries were to disappear, yet there remains a vast system of indigenous industries which are of real importance to the bulk of the Indian people.

I.—INDIGENOUS INDUSTRIES.

The production of *sugar* is India's largest indigenous chemical industry. The yearly output is between 2½ and 3 million tons, but most of the manufactured sugar is a crude material named "gur" or "jaggery." Only 3 per cent. of the total production is refined sugar. The method of manufacture of gur is simple. Sugar canes are crushed in small roller mills turned by bullocks. The expressed juice is treated with lime and boiled down over open fires in shallow pans. The dark-brown product is allowed to set in moulds. In Mysore, a pale-brown or yellow crystalline gur is produced by more careful attention to liming and concentration. The cost of production of gur is low. The capital cost for machinery is only some £15, and the whole factory can be moved to the field where the canes are being reaped. The motive power can be employed for other purposes in the out-of-crop season, and the labour consists simply of the agriculturist and his family. The market is the local village. Hence, in spite of its low technical efficiency, the indigenous sugar industry of India can successfully compete with more up-to-date "imported" methods.

The manufacture of *common salt* ranks next in importance to the sugar industry, the annual output being some 1¾ million tons. The manufacture is almost entirely in the hands of small owners or contractors, who are supervised by Government officials for purposes of taxation. The chief source of salt is sea-water, which is evaporated by solar heat. In the Punjab, however, some 150,000 tons of rock salt are mined annually. Many attempts have been made to improve the quality of Indian sea-salt, but the ignorance of the salt makers, and the fact that a large proportion of the population of Southern India prefer an impure salt, containing bitter magnesium compounds, are factors adverse to progress. In certain districts, a black salt is esteemed, but in Bengal, a clean white salt is preferred. Little attention has been given to the possibility of recovering by-products from the bitterns, but, in any case, the cost of production would probably be too high to meet competition with imported substances, such as magnesium chloride.

After salt-making, *oil pressing* is the next most important indigenous chemical industry. Although a number of oil factories using modern machinery have been erected, a large proportion of the oil pressed in India is obtained by the use of the primitive motar, or "ghani" made of wood or stone, fashioned in conical form. Bullocks or camels supply the motive power. With care, the ghani will produce a good quality oil, and a cake containing 8 per cent. or less of oil. Consumption of oil is almost entirely local. Nearly every village in the oil-seed growing districts possesses its ghani, but the output per mill is small, since a ghani can deal with only about 60 pounds of seeds per day. Nevertheless, it is probable that some 300,000 tons of oil seeds are crushed by ghanis per year in India.

The remaining indigenous chemical industries are of minor importance. The following are chief among them:

Saltpeter is extracted from soil in certain districts, and the crude product, containing 30 to 55 per cent. of potassium nitrate, is usually refined, yielding a product of 94 per cent. purity. The average annual production of saltpeter in India is some 10,000 tons.

Shellac is a material whose production is peculiar to India. Although crude, the mode of manufacture practised has never been satisfactorily substituted. In 1921, there were 151 lac factories in operation, employing some 10,000 operatives.

Essential oils are extracted from plant materials by the simple procedure of boiling the materials with water in copper vessels, and passing the distillate through bamboo tubes into earthenware pots cooled with water. The products are impure; nevertheless, lemon-grass oil, sandal-wood oil, rusa oil, and ginger-grass oil, prepared in this way, are exported in some quantity. Rosewater is produced in large amounts, and also omum water from ajowan seeds. In Northern India, the art of enflourage has been practised for countless years.

Finally, mention must be made of indigenous natural *dyestuffs*. Indigo and madder are the chief of these. Their preparation consists in grinding the appropriate plant material. In the case of indigo, however, an additional fermentation process is usually employed.

II.—IMPORTED INDUSTRIES.

The bulk of the Indian population is not interested in goods made by modern processes, with the exception of cloth, kerosene oil and matches. Distribution of imported goods is difficult and dear, and furnishes the main hinderance to progress. Fuel is scarce, and raw materials are hard to obtain in sufficient quantities.

Hence, such commodities as *iron, lead, silver* and *gold*, although manufactured on modern lines, mainly by British companies, are expensive to produce.

Large scale *wood distillation* by the best American methods, has not proved remunerative. *Mineral oil* production and refining, although successful, especially in Burma, are sufficient only to furnish 70 per cent. of the total consumption of fuel.

Vegetable oil, expressed by engine-driven ghanis, finds a ready market, and the industry is successful. More ambitious processes have not yet justified themselves. The chief obstacle to development is the difficulty of disposing profitably of oil cake. Nevertheless, some 300,000 tons of oil are produced per annum in Bengal and Burma, and of this, one-third is exported.

Soap manufacture has not made much headway, although some 15,000 tons of soap are imported into India annually. There exist about a dozen small factories each producing one or two tons of good quality soap per day. In addition low grade soap is manufactured as a cottage industry, chiefly on the west coast.

Cement manufacture has grown considerably during the last ten years. Raw materials are plentiful and of good quality, but fuel is scarce, and freightage dear. Some 250,000 tons of cement were produced last year in India, but it has not yet been found possible to compete with English cements at the large sea-ports, where cement is chiefly needed, and it is probable that several Indian cement works will soon have to cease operations.

Sugar refining is carried out in eighteen modern factories, of which nine are located in the United Provinces. In 1923, 75,000 tons of refined sugar were produced, two-thirds of which were made from gur, and the rest directly from sugar-cane. There are two main difficulties that confront refined sugar manufacture on a large scale in India. The first is that in many districts, gur is preferred to refined sugar, so that the demand for gur is greater than the supply. In spite of this, some 700,000 tons of sugar have to be imported into India to supply all needs, and it would appear more rational to import refined sugar and consume gur, rather than to produce refined sugar and import a possibly unpopular gur. The second difficulty is the unreliability of a supply of sugar-cane sufficient to maintain large factories, because sugar-cane growing is mainly a peasant industry in India. The only solution appears to be the acquisition of large tracts of land to be farmed by the factory owners. Nevertheless, a sugar corporation formed a few years ago with considerable capital, considered it inadvisable to commence operations on account of this second-named difficulty.

Alcohol is produced in some quantity by Indian distillers and brewers. An interesting collection of distilleries occurs at Hyderabad, where a number of stills, operated by different owners, are all assembled in one large compound to facilitate revenue control. These stills vary in type from the most primitive to the most modern. They use mainly mahua flowers (*Bassia latifolia*) as raw material. Attempts are being made there to manufacture a motor-spirit similar to Natalite. Many of the distilleries produce compressed carbon-dioxide for use in making soda-water.

The remaining imported chemical industries in India produce *sulphuric acid*, manufactured from imported sulphur; certain "*heavy chemicals*" in small amount; inadequate supplies of *oil paints*; *opium* and *quinine* at Government factories, and essential oils, particularly *sandal-wood oil*, whose manufacture has provided a distinct success. True sandal-wood (*Santalum album*) grows in appreciable quantity only in India, and two large factories, recently erected in Mysore, now produce the greater part of the world's supply of genuine sandal-wood oil.

Cinnamon oil, Clove oil, Cardamon oil, thymol, turpentine, resin and other similar products, are also manufactured in increasing quantities in improved factories in Mysore and the Punjab.

III.—CONCLUSION.

With the exception of the mining industries, the only venture of any magnitude that has so far been an unqualified success in India is the manufacture of sandal-wood oil. Where indigenous industries have been improved by the use of power-driven machinery, success has also usually followed. The best example of this is the oil-pressing industry. Whilst it is probable that some parts of India will develop in the future along western industrial lines, it is difficult at present to state when such a change will materialise.

F. HARDY.

RESEARCH.

WE do not remember reading a better brief definition of the meaning, aims and value of scientific research than that given in the following abridged quotation, which is taken from the journal *Oil Power*.

The prodigal use of supposed limitless resources, has been the foundation on which huge industries have been built. In recent years, it has become apparent that these natural resources, however, *have* a limit, and that national wealth and security depend in a measure upon their conservation. The realization of this fact is responsible for the birth of the art of industrial research.

Scientific research is as old as humanity. Its inception is the physical satisfaction of human curiosity. Its ultimate object is that the living plane of mankind may be raised, and that the world's natural resources, mankind's heritage, may be conserved. Those charged with the control of industries to-day are responsible that their industry, by research, shall add its mite to human progress and to material conservation.

TROPICAL WORLD NOTES.

Guatemala.

General prosperity prevailed in Guatemala last year. This was manifested in various improvements in the country, particularly in highways, public buildings, and parks, and the general condition was reflected in the railway and dock improvements, in the importation of luxuries, such as motor cars and fine woven fabrics, and in better highway transportation.

Products exported from Guatemala were valued at nearly $30,000,000 as compared with $24,500,000 in 1924, while imported goods amounted to $18,500,000 as compared with $14,500,000 in 1924. The United States, as usual, was the largest source of supply, and also by far the most important customer, her share in the import trade being 60 per cent., and her purchases from Guatemala nearly one-half of the total export trade. The share of England (including British Honduras) in the import market was nearly 14 per cent., ranking this country next to America, and in the exports of Guatemala's product less than 2 per cent.

In the course of his message to the National Legislative Assembly of Guatemala, which opened recently, President Urellana mentioned that much had been done toward developing the country, and that cereal crops were normal, with the exception of maize which had fallen by 10 per cent. Coffee would probably show a drop of 12 per cent., as compared with the previous year, but there was compensation in better prices, which would also encourage new planting.

The sugar crop would be abundant, but low prices prevailed. Decreases were noted in the cotton and tobacco crops. There had been considerable increase in the number of cattle, for which reason a Decree prohibiting the export of cattle had been revoked. A convention had been signed with Chile for the protection of trade marks, commerce, and agriculture, and commercial treaties were about to be signed with Great Britain, Italy, and Holland, on equitable bases, which would undoubtedly be of great benefit to international trade.—*Chamber of Commerce Journal.*

Ecuador.

A law has been passed by the Government of Ecuador exempting all national industries from taxation for a period of five years; *i.e.* all the manufacturing industries established in Ecuador and in which a minimum of 33 per cent. of the capital is Ecuadorian.

The Government and all other Public Institutions must give preference to goods made in Ecuador where the price of the Ecuadorian article equals that of the imported. Imported machinery, chemicals, &c., &c., needed to establish or to run the industries are also exempted.

Gold Coast.

Nearly all the principal products exported from the Gold Coast last year showed increases, which, in the case of rubber and manganese ore, were very considerable. Official statistics give the total value of the Colony's exports of domestic produce and manufactures, including bullion, as £10,626,731, as compared with £9,590,121 in 1924. Diamonds, manganese ore, rubber, copra, palm oil and sisal hemp fibre all advanced in quantity and value, and higher prices for cocoa compensated for a smaller export trade in this product.

The total export of diamonds was 77,313 carats, valued at £98,760 an increase of 10,367 carats and of £13,399 in value, due to a further development of the diamond industry, which was commenced only a few years ago.

The record figure of 338,657 tons was reached in shipments of manganese ore, the increase being 105,255 tons. This favourable result was due to the employment of a larger staff and improved machinery at the mine at Insuta, and also to improved railway and water carriage facilities. The Gold Coast now supersedes Brazil as a producer of manganese, and ranks next to British India which in 1921 produced about 680,000 tons.

An advance in the price of rubber in the world's markets was responsible for increasing the Gold Coast production of this commodity. For a number of years the collection of rubber in the Colony had not been a remunerative industry, but last year shipments increased in value by £25,029 and in quantity by 825,650 lb.

The Government is endeavouring to develop the copra industry in the Gold Coast, and it is anticipated that in about seven years' time there will be a considerable increase in the quantity exported. Last year shipments reached 1,324 tons, valued at £30,704, being an advance of 161 tons and £4,028 as compared with 1924.

Started by the Government some years ago, the sisal hemp industry has now passed beyond the experimental stage, and exports in 1925 amounted to 176 tons, valued at £6,995. The area planted with fibre covers 1,000 acres, but in order to keep the machinery employed to its full capacity, and in order to make the plantation a commercial success, an area of at least 6,000 acres is required. Now that the Government has proved the feasibility of establishing the industry in the Colony on a commercial basis, it is to be hoped that native chiefs in proximity to the sisal plantation will interest themselves in its development.

The Gold Coast does an enormous export trade in cocoa, that for last year amounting to 218,151 tons, valued at £8,222,263, which was less in quantity by 5,178 tons but more in value by £972,385 than similar shipments in 1924. The Colony remains the chief cocoa producing country

in the world, shipments last year representing upwards to 50 per cent. of the world's consumption. Brazil is the second producing country but she turns out only about one-third of the Gold Coast production.

Of other products of the Colony, gold and kola nuts are important. Last year exports of gold decreased by 14,448 ounces, in quantity, and by £34,483 in value, owing to labour difficulties and to one mine ceasing to produce. Kola nuts dropped from 17,411,694 lb. in 1924 to 13,656,162 lb. last year, but in addition to these quantities a considerable amount was exported overland to Nigeria.—*Chamber of Commerce Journal.*

Nyasaland.

According to a recently published colonial report the external trade of Nyasaland in 1925 reached a total of £1,294,301 showing an increase as compared with 1924 of £15,894. Of this amount £137,721 was accorded to transit trade. Total imports in 1925 were valued at £591,654, as compared with £548,156 in the preceding year, while exports amounted to £564,926, as against £583,555.

Imports from the United Kingdom were valued at £295,844, or 50 per cent. of the total value of domestic imports, as compared with a value in 1924 of £316,288, or 57.7 per cent. British Possessions accounted for 23.5 per cent. of the imports, as against 18.2 per cent. in 1924. Foreign countries supplied goods to the value of £156,482 or 26.5 per cent. during the year, receipts from the same sources during 1924 totalling £132,249, or 24 per cent. of the total importation.

The following constitute the principal products of the Protectorate exported in 1925, the figures for 1924 being in parentheses:—Cotton, 22,918 centals (22,293); tobacco, 3,088 tons (3,145); fibre, 785 tons (800); tea, 516 tons (472); rubber, 71 tons (78); capsicums and chillies, 10 tons (16); and coffee, 9 tons (22). The total weight of domestic exports showed a slight decrease as compared with the previous year. In spite of what was regarded as an unfavourable season for tobacco, the shipments of that commodity showed a decrease, as compared with 1924, of only 56 tons or 1.8 per cent. Shipments of cotton, equivalent to 1,023 tons, showed an increase of 28 tons. This year's crop is estimated at over 2,000 tons. Of the total value of domestic products, the United Kingdom absorbed 98.6 per cent., British Possessions took 0.23 per cent., and foreign countries 1.17 per cent.—*Chamber of Commerce Journal.*

Venezuela.

Although Venezuela has six cotton mills which manufacture a large portion of the cotton cloth consumed and also supply the domestic market to a certain extent in other lines of cotton manufactures, there is a fair market for American and British goods. The American Consul at Caracas considers that the future prospects for sale are fair. Some merchants are optimistic regarding possibilities, but others entertain rather pessimistic views because of the far-reaching effects of the recent additional tariff duties, which will bring about higher prices and decreased consumption. The domestic mills, however, are not yet able to make articles of a sufficiently good quality to satisfy the Caracas trade.

Great Britain leads in supplying the better grades of cotton goods and has also furnished some of the less expensive qualities. In recent years, however, about 75 per cent. of the cheaper grades has come from the United States. Many dealers state that competition from the constantly increasing local production of cotton drills and other textiles is not as active as might be supposed, because the consumers in the city demand a higher quality than the domestic article. In the cities imported drills are accorded a marked preference and would probably continue in greatest favour, but for the additional, and in some cases prohibitive, Customs duties above referred to.—*Chamber of Commerce Journal.*

Tanganyika.

The steady and satisfactory improvement that took place in the trade of the Territory during 1925 is fully borne out by statistics in the Trade Report for 1925, issued by the Comptroller of Customs for that Colony. The value of the exports as compared with 1924 showed an increase from £2,611,303 to £2,901,315 or 1.11 per cent., while imports increased from £2,062,646 to £2,863,917 or 38.9 per cent. The total percentage of imports direct from foreign countries, principally Germany, was 35.5, the bulk of the goods emanating therefrom being materials such as beer, ale, iron and steel manufactures and cycle accessories. In this connection brief reference might be made *en passant* that Germany continues to make rapid progress, her exports to Tanganyika during the year under review rising to £300,028 or 10.5 per cent., of the Territory's imports as compared with £134,055 in 1924. Grain, coffee and cotton were the most valuable articles exported from the Territory during the year under review, the greater percentage of these articles going to the United Kingdom and other parts of the British Empire. Owing to climatic conditions causing a partial failure of the ground-nuts and cotton crops, the phenomenal progress the Colony anticipated had not been realised, but the report forecasts a considerable increase in the output of cotton during 1926.

ACCORDING to the report of the Mid-Bohemian Sugar Society, the sugar production in Europe increased 40 per cent. in the season 1924-25 while at the same time the cane production of the world increased 500,000 tons. Because of this rapid increase in which the consumption did not bring up the rear, the society believes that the untoward conditions in the markets can be accounted for.—*Planter and Sugar Manufacturer.*

CACAO FERMENTATION.

Two suggested substitutes for the customary plantation practice.

PROFESSOR F. HARDY, M.A.

IN the May issue of this Journal, 1925, Vol. II, p. 99, S. F. Ashby gave a concise account of the objects and methods of cacao fermentation or "sweating," together with some biological facts concerning the cause and course of the changes that occur during this process. In the November issue, 1925, p. 256, the writer considered the subject from a physico-chemical point of view. Whatever be the observed phenomena of cacao fermentation, it appears that heat or acidity, or both, are the main operative factors that produce the *results* of fermentation, by markedly increasing the permeability of the cells of the cacao embryo, and thereby permitting free intermixture of their contents.

1.—*Heat treatment as a substitute for fermentation.*

Attempts to produce the results of natural cacao fermentation by subjecting fresh, ripe cacao beans to simple heating, have been made at various times. Apparently the first precise effort was made by Fickendey in 1910 who heated pulp-freed cacao beans to a temperature sufficient to "kill," or render highly permeable, the cell-walls of the embryo, but not to destroy the specific enzymes that control the conspicuous changes which immediately follow.

Recently, a similar heat-treatment has been advocated by Dr. F. L. Stevens, of the University of Illinois. Dr. Stevens' procedure is described in a paper read at the Pan American Scientific Congress in December, 1924. It is reprinted in the March, 1926, issue of the *Proceedings of the Agricultural Society of Trinidad and Tobago*, Vol. XXVI, pp. 149-160. The experiments, some 200 in number, were performed at Illinois University with material supplied by the United Fruit Company. The objects were two-fold, namely, (1) to produce a commercial bean of lighter colour than that obtained in the ordinary fermentation process practised on the United Fruit Company's estates, and (2) to produce a bean less acid than that produced by the usual method. Dr. Stevens claims to have succeeded in both objects.

The heat factor was examined by determining (*a*) the exact temperature needed to kill the cacao embryo, and (*b*) the temperature that it is possible to employ without danger of injuring the enzymes. It was found by carefully-controlled experiments with beans held in glass jars suitably supplied with oxygen and immersed in water-baths maintained at constant temperatures, that, at 60°C., the cacao embryo was easily killed in less than half-an-hour. At 45°C., nearly 24 hours exposure was needed to kill the embryo. At 60° C., however, the enzymes were quite unimpaired, no matter how long the time of exposure. On the other hand, at 90°C., not only were the embryos killed, but the enzymes were completely destroyed even by four minutes heating. At 80°C., and at 72°C., most beans escaped enzyme injury, and at 65°C., all beans escaped, in a ten minutes exposure. Hence the conclusion was drawn that there is "ample margin between the death-"temperature point of the embryo and the "destruction point of the enzymes."

Further experiments were subsequently inaugurated to determine the exact temperature and time most favourable to the killing of the embryo with least injury to the enzymes, and least adverse effect on the final appearance of the bean. The results are not stated, because it was thought that they needed verification by trials under tropical conditions. Nevertheless, the fundamental conclusion was established that "temperatures from 40° to 60°C., for several "days—killing the embryo without destroying the "enzymes—result in the desired colour changes "in the embryo."

"In all the experiments, the beans were handled "carefully to avoid bacterial contamination, so "that but few bacteria or yeasts were present. "Therefore the colour changes were due to heat, "and in no way to bacteria or yeasts. It therefore "appears that the one essential thing is to kill the "embryo and allow the enzymes to act. The "essential process, is therefore not a fermentation "at all."

Acidity or sourness was obviously completely avoided in Dr. Stevens' experiments, and so much superior were the resulting samples to commercial beans submitted by the United Fruit Company, and made from raw beans of the same quality by the ordinary plantation process, that "Allegretti's "cacao buyer priced them at a much higher "figure, varying from one to three cents a pound, "due to their superior colour, aroma and lack of "acidity." The report of the manager of the United Fruit Company's estates in Costa Rica stated that "to say that we are delighted with "the wonderful progress you (Dr. Stevens) have "made, is putting it mildly indeed."

In order to ascertain whether bacteria or yeasts alter the quality of the product, Dr. Stevens inoculated beans, killed by heat, with pure cultures of various organisms, and incubated the treated beans at 37°C. for several days. Different effects on aroma, taste and degree of acidity were thereby produced, and it was consequently surmised that micro-organisms, growing in normally fermented cacao, liberate various chemical substances that penetrate into the beans and alter their qualities. Moreover, none of the micro-organisms tried gave any beneficial results, although many of them produced undesirable effects, notably increased acidity. Dr. Stevens, therefore, suggests that undesirable acidity in commercial cacao beans is due entirely to the presence of certain micro-organisms in the fermenting mass, and that these micro-organisms

are unwanted. In plantation sweat boxes, the heat needed to kill the embryos is generated by living organisms, mainly bacteria and yeasts. The heating of the mass is very irregular, however, even when the mass is periodically turned. Hence the temperature is sufficiently variable to allow all sorts of undesirable organisms to multiply and to produce acids that are subsequently absorbed.

In conclusion, Dr. Stevens states that oxidation in cacao beans, producing the desirable colour changes, can proceed just as well when the beans are immersed in, and are in actual contact with water as not. He, therefore, recommends that the embryos be killed by immersing the beans in water in a tank furnished with steam-coils. This would save several days in comparison with the sweat-box method. After death due to immersion, he recommends that the water be kept at 60°C. until the enzymes have had sufficient time to act, *or*, that the killed beans be placed in tanks *without* water, still maintaining a temperature above that at which undesirable micro-organisms thrive, but below that at which the enzymes are destroyed. Beans treated thus do not develop moulds when subsequently stored under proper conditions.

Finally, Dr. Stevens suggests that different varieties of cacao, and beans of any one variety at different stages of maturity, may require somewhat different temperatures for successful curing. He urges that these possibilities should be tested.

Dr. Stevens' findings agree substantially with the earlier results of Fickendey already cited. Fickendey recommended 24 hours heating at a temperature between 50° and 60°C. (122° to 140°F.) as a substitute for the usual plantation method of cacao fermentation. Apparently his work has had little effect on commercial practice.

Effect of maturity on the results of fermentation.

It is interesting to compare the views of Dr. Stevens as to the importance of degree of ripeness on the results of cacao fermentation, with the experimental results obtained by Mr. A. W. Knapp, Research Chemist to Messrs. Cadbury, Bournville, England, and reported in an article that appeared in the *Journal of the Society of Chemical Industry*, 21st May, 1926, pp. 140T—to 142T.

Mr. Knapp conducted his experiments in Trinidad, in 1913, at Ortinola Estate. Two lots, each of 600 lb. weight, of fresh cacao beans were obtained. One lot was unripe; the other, six weeks overripe. Both lots were fermented in sweat boxes side by side. Two other adjacent boxes were filled with ordinary estate fresh cacao beans for comparison. Fermentation was allowed to proceed in every case for 5½ days, the beans being turned once a day. Temperature changes were recorded.

Unripe Cacao.

The temperature rose during the first 15 hours to 40°C. (104°F.), but soon dropped to 34°C. (93°F.), where it remained fairly constant throughout the whole period of the run. This temperature is not high enough for correct fermentation; the beans became excessively slimy and gummy. Unripe pulp probably contains insufficient sugar for the support of an adequate micro-organic flora requisite for suitable heat generation. The yield of *dry* cacao, however, was considerably less than that obtained from normal beans (21 lb. as against 44 lb.). The dried, unripe cacao was crisp, but held the shell tightly. Its colour was pale, resembling tinted ivory, and its texture woody. Its aroma was sharp and slightly empyreumatic. Its fat content, contrary to expectation, was relatively high (55.8 per cent.). The product was valued at 55 to 56 shillings per cwt., as against 60 shillings for the normal cacao.

Over-ripe Cacao.

During the first 48 hours, the over-ripe cacao, fermented more quickly than the normal, but it subsequently maintained similar temperatures (about 43°C., or 113°F). The fermentation was satisfactory, and a little ahead of that of the normal beans. The yield of dried over-ripe cacao was about the same as that of normal beans. The dried cacao was crisp, but rather fragile. Its colour was the normal cinnamon brown; its aroma fairly good, and its fat content not far from the average (51.8 per cent.). The product was valued at 59 shillings per cwt. Over-ripeness, therefore, leads chiefly to excessive fragility in the dried cacao. If excessive, over-ripeness may result in inferior aroma and keeping quality.

Mr. Knapp's experiments certainly indicate that *under-ripe* cacao beans are deficient in certain components (probably including enzymes) that are responsible for the development of desirable colour and aroma in dried cacao.

2.—*Acid treatment as a substitute for cacao fermentation.*

In a former article (this *Journal*, November, 1925, Vol. II, p. 256), the writer suggested that, since a certain degree of acidity (pH. 3.8) effects the killing of the cacao embryos without destroying enzyme activity, a suitable acid treatment may bring about the same results as ordinary fermentation or as simple heating. Indeed the acid method has long ago been advocated by Loew, and by Schulte-im-Hofe, but these investigators worked empirically, and their object was not definitely to elaborate a method alternative to the ordinary fermentation process. Mr. Knapp (*loc. cit.*) attempted to find by experiment whether or no an acid treatment would accelerate the reactions that occur during cacao fermentation. He treated 3,000 lb. of fresh ripe Trinidad cacao in a sweat box with an aqueous solution containing 2½ to 4 per cent. acetic acid (pH. probably 2.6 to 2.4) added in two portions of 43 pints each, on successive days. He compared the effects of this treatment with the normal course of fermentation in another lot of 3,000 lb.

weight of fresh cacao contained in another sweat box. He concluded from his observations that, in the treated sample, "the presence of acetic acid " did not hamper the fermentation " (in spite of the rather high degree of acidity) and that, " in " appearance the treated beans were one day ahead " of the ordinary." No material difference was noted in the dried products, and a broker valued them both at the same price. Mr. Knapp states that " acetic acid assists those colour changes " which are associated with fermentation, but it " does not appear to assist the production of the " substances on which the aroma and taste " of cacao depend."

Mr. Knapp apparently assumes that acid treatment merely " assists " fermentation. The writer holds, however, that it may simulate or replace it. Contrary to expectation, and contrary to Dr. Stevens' beliefs, Mr. Knapp's treatment did not apparently give undesirable acidity in the final dried cacao. Nevertheless, it appeared to have no beneficial effect on aroma and taste. Perhaps, as the writer has suggested in his former article, *citric acid* may effect both improved rate of curing *and* improved aroma and taste, because citric acid is a natural component of cacao pulp. At any rate, treatment with dilute citric acid, of pH value approximately 3.8, is certainly worthy of trial on a large scale as a possible substitute for the fermentation process of cacao curing, as well as a substitute for the proposed heating process advocated by Dr. Stevens. The trial should be made both with unsterilized fresh cacao, and with cacao that has been sterilized by treatment with a germicide such as formalin or toluene.

Summary.

Two suggested substitutes for the customary plantation sweat box method of cacao curing are described. They are (1) a *heat-treatment*, which consists in immersing ripe cacao in water heated to about 60°C (140°F.) This quickly kills the embryos, but does not injure the enzymes. The cacao is either left undisturbed at this temperature long enough for the enzymes to act, *or*, the killed beans are put in a tank *without* water, and maintained at 60°C for the desired time. The heating process has been tried in practice. (2) an *acid-treatment*, which consists either in immersing ripe cacao in dilute acid (preferably *citric acid*) of pH 3.8, *or* wetting the cacao once or twice with dilute acid. It may be an advantage previously to disinfect the cacao by treating it with a cheap germicide. The acid process has *not* yet been tried in practice.

ADVERTISEMENTS.

MR. HENRY H. R. MOLE, of Little Neck, Long Island, New York, has been appointed advertising agent for *Tropical Agriculture* in the United States of America and Canada. All communications from those countries respecting advertisements should be addressed to him.

SUGAR INDUSTRY OF QUEENSLAND.

THE latest Annual Report of the Director of the Bureau of Sugar Experiment Stations, Queensland, records a very satisfactory progress in the sugar industry of that state. The past five years have seen a marked increase in the acreage under cane and in the number of cane-growers. In 1920 the total area under cane was 162,619 acres, and in 1924 this area had increased to 253,519 acres. During the same period the number of cane-growers increased from about 4,000 to over 6,000. The 1925 season was particularly favourable for the growth of the crop, and it is expected that the production of sugar will exceed all previous records. The crop of cane for the season is estimated at about $3\frac{3}{4}$ million tons, giving a yield of 484,000 tons of raw sugar, as compared with 3,176,142 tons of cane and 409,136 tons of sugar in the 1924 season. In addition to this amount for Queensland, it was anticipated that New South Wales would produce some 32,000 tons, while Victoria's beet sugar factory had yielded 3,017 tons in 1925. This should give an approximate production for Australia of 519,017 tons of sugar, which considerably exceeds the home consumption.

The average annual yield of cane per acre for the six years ending 1924 was less than during the previous decade. This is attributed to the number of dry seasons experienced. The yield of sugar per acre, however, has increased, since the number of tons of cane required to make a ton of sugar is now much lower. This favourable result is due largely to the improved efficiency of the mills and to the work of the Cane Prices Board and the Sugar Experiment Stations. There are three such stations, situated in the northern, central and southern cane-growing areas, where manurial, selection and other experiments are conducted to suit the conditions of the respective districts. Work on insect pests forms an important part of the work of the Bureau, and special attention is devoted by the Division of Entomology to the sugar-cane grub, which is the worst pest of the cane in Queensland. Three Field Assistants inspect the cane areas and give advice to growers, whilst another officer travels through the various districts giving advice on the control of diseases and pests and assisting farmers to recognise them. From the reports of the Field Assistants it is evident that the production of farmers who use lime, green manures and fertilisers is much too small. At present there seems to be a tendency for farmers to obtain their crop in comparatively small yield on large areas of land. It is pointed out that this state of affairs must be reversed, but this can be done by the intelligent use of better methods of cultivation and manuring. A hopeful sign in this connection is the greater interest in experimental work that has been taken in recent years by farmers generally.

With few exceptions, all the sugar-growing areas of Queensland are along the coast. The industry is extending rapidly in the northern

districts, where the high rainfall and humid atmosphere are better suited to the growth of the cane. In the districts north of Townsville the output of sugar has increased from 57,135 tons in 1910 to an estimated production of 215,550 tons in 1925, whilst in the same period the area under cane has increased more than 100 per cent. As indicating the importance of the sugar industry to the state, it may be mentioned that a far larger increase in population during the past few years has taken place in these districts north of Townsville than in any other part of Queensland—*Bulletin of the Imperial Institute, June*, 1926.

DETRIMENTAL EFFECT OF CANE TOPS ON THE SUGAR RECOVERY.

By W. SCOTT, B.Sc.

THE following experiments illustrate the loss caused by the delivery to the mill of improperly topped canes.

Canes with green tops were selected from trucks in the factory yard; the tops (including green cabbage and white joints) were cut off at the base of the sheath.

Canes and tops were ground in a laboratory cane mill and analysed separately. The analysis of the whole cane, as given below, was calculated from those separate analysis.

TABLE I gives the average results of three tests.

TABLE I.

	% Sucrose.	JUICE.			% Weight.
		Brix.	Sucrose.	Purity	
Tops only ..	4.17	12.23	5.43	44.39	11.84
Topped Canes ..	12.71	18.20	15.38	84.50	88.16
Whole Canes ..	11.65	17.50	14.39	82.22	100.00

A lower sucrose extraction was obtained from the tops than from the remaining portion of the cane. Allowing for this, but otherwise using figures representing normal factory conditions, we found that the tonnage of cane required to produce a ton of sugar worked out as follows:

Canes free from tops .. .. 8.72 tons.
Canes with tops .. .. 10.34 tons.

The tops, representing 11.84 per cent. of the weight of the cane, were responsible for an increase of 18.42 per cent. in the tonnage of cane required to produce a given quantity of sugar.

It is therefore evident that the tops, while producing no sugar, cause an appreciable loss of the available sugar contained in the richer portion of the cane.

TOBACCO.

Crop Rotation.

EXTENSIVE field experiments have been in progress in southern Maryland for several years to determine whether legumes and other soil-improving crops, combined with artificial manures, can be used successfully in applying intensive methods to tobacco culture. The results are recorded in the *Journal Agricultural Research*, (1925, 30, 1095), and show that although tobacco is not especially injurious to the general productiveness of the soil, it is particularly sensitive to the effects of preceding crops, and attempts to apply intensive methods such as turning under nitrogenous crops and applying large quantities of manures are likely to fail. Hairy vetch, crimson clover and rye as soiling crops in continuous tobacco culture have given rather large increases in yield of tobacco during the first few years of the tests. In later years the yields have been very variable, and in wet years less than that of the control plot, while the growth has been uneven and the leaf of poor quality and high nitrogen content. Much the same results have been obtained when crimson clover and cowpeas have been used as soiling crops for tobacco in a two-year rotation with wheat. In a three-year rotation of tobacco, wheat and red clover, both the yield and quality of the tobacco have been more stable and on the average higher than those of the control plot. It is possible, however, that the result is due to the fact that the land is substantially in a resting condition for the greater portion of the rotation period. None of the cropping systems tested have given results with tobacco equal to those obtained on rested land.

Seed Disinfection.

Experiments have been made by the Department of Agriculture, Rhodesia, to determine the effect on the germination of tobacco seed of treatment with formalin as a means of protection against the bacterial diseases, known as wildfire and angular spot. The results are recorded in *Rhodesia Agricultural Journal*, (1925, 32, 861). In no case was the seed permanently injured by the treatment, but germination was retarded, especially that of small and light seed of low vitality. Whereas 76 per cent. germinated in 8 days and 92 per cent. by the end of 25 days in the case of untreated seed, only 56 per cent. germinated in 8 days and 89 per cent. in 25 days when the seed had been previously treated with formalin.—*Bulletin of the Imperial Institute, June*, 1926.

Subscriptions to Lord Milner's Appeal for £100,000 as an endowment fund for the Imperial College of Tropical Agriculture should be addressed to the Secretary, Imperial College of Tropical Agriculture or to the bankers of the Fund, the Colonial Bank, 29, Gracechurch Street, E.C.

COFFEE INDUSTRY OF CUBA.

OWING to the continued higher prices for coffee, there is reported to be an increasing tendency toward increased production in Cuba, though general conditions do not indicate much expansion. Annual consumption runs some 70,000,000 pounds a year, of which half is raised locally and the rest imported. The Department of Commerce at Washington gives out the following report on coffee growing in Santa Clara Province :

" At one time, under the Spanish government, coffee was an important crop in Cuba, being grown not only for domestic consumption but also for exportation. At present, however, due to the development and success of the sugar-cane industry, practically all the available land in this district is devoted to cane or tobacco, except such mountainous tracts as are unsuited for anything but coffee. Landowners, however, in periods of low sugar prices, show a tendency to convert some of their cane lands into coffee, tobacco, and other products.

" Of the 200 coffee plantations in Cuba, practically all are unimportant and operate in a small way. The Trinidad mountains, extending between Cienfuegos, Trinidad, and Sancti Spiritus, all in the south-eastern part of the province of Santa Clara, are considered to be the best lands for the raising of coffee, most of the growers in this district being engaged there.

" None of the coffee grown here is locally exported, a ready market being found in the towns near the plantations, and, while Porto Rican coffee seems to be preferred, Cuban coffee is of high grade and commands a price little if any less than that of other countries. Coffee retails in local stores at 60 to 65 cents a pound. Green coffee f.o.b. in the towns brings around 25 cents a pound.

How coffee is cultivated.

" The methods of cultivation are more or less as follows : The coffee is planted in rows, the plants about 33 inches apart and in shade, such as wooded land. The planters frequently make the mistake of planting the coffee too close together, so that in the fifth year the foliage unites, producing a forest of coffee trees and little coffee. After planting, two cleanings should be given annually, hilling the ground if possible. The third year the trees begin to bear, and from the fifth to the sixteenth year an average yield of six pounds of coffee may be expected per plant. The harvesting begins in September and terminates in December. The coffee is piled and left for 3 or 4 days to permit fermentation, then spread over the drier, where it remains for 15 or 20 days, care being used to protect it from rain and dew. The coffee tree should be trimmed annually in order to sustain production.

" The harvesting comes at a time when labour is most plentiful and it is not believed that any serious labour difficulties would be encountered. Ordinary labourers are paid $1.25 to $2.00 a day. usually without board, though small huts or sleeping quarters are frequently provided.

" In considering the cultivation of coffee in this district, conditions of the roads over which the product passes to market must not be overlooked. Many are so bad, particularly in the mountain districts, that they are impassable during the rainy season, and for this reason transportation is frequently one of the heaviest expenses in the raising and marketing of Cuban products. Coffee is usually carried in 100-pound sacks by mule, no other means of transportation being possible."

The Annual Consumption.

The Cuba Foodstuff Record has this about imports of coffee into that republic :

" The population of Cuba considers coffee its favourite drink, 1924 imports having reached nearly 36,000,000 pounds, valued at $7,100,000. There is besides 30 per cent. to 50 per cent. of that amount grown in the island and consumed locally, as there is little or nothing exported. Countries exporting coffee to Cuba were as many as 20 in 1924, Porto Rico leading with 30 per cent. of the total, and Brazil, United States, Salvador, and Venezuela following, besides every Central American republic with which we maintain regular steamship connections."—*The Tea and Coffee Trade Journal.*

SUGAR CROP OF MARTINIQUE.

THE 1925-26 sugar season on the island of Martinique, French West Indies, has ended with a production estimated at 40,000 metric tons of sugar, against a 1924-25 outturn of 48,121 tons, according to a consular report from Fort de France. As the 1924-25 crop was above the average of previous years, the current season's outturn is regarded as very satisfactory. The number of mills operating was three more than last year, due to the re-equipment for sugar production of three plants formerly engaged in distilling rum. These distilleries were not in a position to work up the cane available and sugar equipment was accordingly added.—*Facts About Sugar.*

INSECT MIGRATIONS.

Two insect migrations have been observed in Trinidad this season.

Commencing early in September, and for a period of more than two weeks there were to be seen on those days when the weather was fine, great numbers of yellow butterflies flying in a generally south-westerly direction across the College savannah. The flight, so far as observed, began shortly before mid-day, between 10 and 11 o'clock and continued for some three hours or more. The insects appeared to be all of one species, and the specimens collected were identified as the Yellow Migrant *Catopsilia statira.*

Shortly after the migration of butterflies was over, there appeared great numbers of the Green Page Moth *Urania leilus*, flying in a generally northerly direction. This large and showy day-flying moth comes from Venezuela. Their migrations sometimes reach Barbados.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Ethylene Glycol.

Ethylene glycol, the simplest of the polyhydric alcohols, formula, $CH_2OH.\ CH_2OH.$, is another example of a chemical compound which, until recently, was of theoretical interest only. Its cheapened large-scale production during the past five years, however, has opened up a large field for its industrial use, so that soon its name may become commonplace. In these respects, ethylene glycol may be compared with furfural and with cyclo-hexanol, both of which have already been described in this Journal.

Ethylene glycol will probably find greatest employment as a solvent and as an " antifreeze " compound for adding to water. From it, a number of derivatives, such as glycol dinitratec (a suggested ingredient of improved dynamite), may be readily prepared.

An authoritative list of the established physical properties of ethylene glycol has been compiled by Messrs. C. A. Taylor and W. H. Rinkenbach, in *Industrial and Engineering Chemistry*, July, 1926, p. 676. These investigators are engaged in a detailed study of glycol dinitrate for the Bureau of Mines, Pittsburgh.

Ethylene glycol is a colourless, odourless, viscous liquid. Its taste is sweet, resembling that of glycerine (a trihydric alcohol). It does not solidify until its temperature is lowered to 11° or -18° Centigrade. It boils at 197°C. The liquid is very hygroscopic, and is comparable with sulphuric acid and with absolute ethyl alcohol in this respect. Ethylene glycol is miscible in all proportions with water, glycerine, alcohols, acetone, glacial acetic acid, pyridine and furfural, but is not miscible with liquid hydrocarbons nor with chloroform, ether, carbon tetrachloride and carbon bisulphide. It is a good germicide, as is ethyl alcohol, and is superior to glycerine in this respect.

Charcoal-gas as motor fuel.

In continuation of a former note on this topic, it is interesting to learn from a letter by Mr. S. H. Davidson in *The Spectator* for 19th June, 1926, that, during the war when fuel was scarce, exhaustive experiments on charcoal-gas for driving motor-cars were carried out in Egypt by the late Mr. John Wells, for the Egyptian Government. Mr. Wells ran several motor lorries on gas derived from cheap combustibles such as cotton stalks. Further information on the subject could possibly be obtained from the Mechanical Transport Department of the Ministry of Transport, Cairo.

Vegetable Dyestuff tannins.

Tannins are chiefly used in leather manufacture, but certain of them are still largely employed as dyestuffs. The chief tannin-dyestuffs are (1) tannic acid (obtained from oak galls), (2) myrabolans (from fruits of species of *Terminalia*), (3) sumach (from leaves of *Rhus* species), (4) chestnut (from heart wood of *Castanea vasca*), (5) divi-divi (from pods of *Caesalpinia coriaria*), (6) valonia (from acorn cups of a Mediterranean oak), and (7) Cutch or Catechu (from various catechin-containing plants, such as *Uncaria gambier*, *Acacia catechu*, *Areca* or betel-nut palm, and mangrove). Tannic acid is chiefly employed in mordanting cotton for bright shades, myrabolans and sumach for dyeing cotton, and the rest, for black-dyeing and weighting silk.

Tannins are classified by the dyer according to their chemical decomposition products, into two main classes. One class yields catechol on heating; the other class yields pyrogallol. Catechol tannins deposit " reds " or phlobaphenes on warming with dilute mineral acids, whereas pyrogallol tannins deposit white ellagic acid on similar treatment. Catechol tannins give intense greenish-black colorations with iron salts, but pyrogallal tannins yield blue-black iron compounds, which at one time comprised the only black writing-inks used.

In the above list of dyestuff-tannins, the first five belong to the pyrogallol (iron blueing) tannins; valonia has properties common to both the pyrogallol tannins and the catechol tannins, whilst the last (cutch), is a typical catechol (iron-greening) tannin.

Manganese and Plant Growth.

The recent work of Dr. J. S. McHargue, described in *Industrial and Engineering Chemistry*, 1926, p. 172, has again shown that manganese is indispensable for plant growth, and is particularly concerned in the synthesis of chlorophyll. Plants deprived of manganese developed chlorotic leaves, and contained smaller amounts of starch and sugar than normal plants. In manganese-starved plants, growth soon ceased altogether. A considerable time (about 6 weeks) must elapse before manganese is exhausted from the seeds of normal plants that are grown in sand cultures devoid of manganese. In normal seeds, manganese is localized in the germ. In fruits, it may be localized in the pericarp.

A new Denaturent for Alcohol.

The Italian Government has authorized the use of a new denaturent for alcohol. It consists chiefly of ichtyol oils (fish oils). It supercedes the former favoured denaturent which contained pyridine, benzol, and methyl alcohol. Three parts of the new denaturent to 100 parts of alcohol is the ratio recommended.—*The Chemical Age*, May, 1926.

INTERNATIONAL SOCIETY OF SUGAR-CANE TECHNOLOGISTS.

THE International Society of Sugar Cane Technologists held its first meeting in 1925 in Honolulu, and the second meeting is now being announced to be held in Havana, Cuba, in March, 1927.

The following is the text of a circular which announces the data and plan of the meeting and sets forth the objects of the Convention. The circular which is addressed to the members of the Society is signed by Mr. H. P. Agee, General Chairman, and the covering letter under which it is sent out, states that Membership in the Society is open to those who are interested in the technical problems of sugar production.

"Arrangements have been made with the Cuban Government to hold the next convention of this Society in Havana. The meetings will open on 14th March, 1927, and continue for about a week, with side trips in and about Havana. Following this, an excursion will be made to other parts of Cuba either in small groups or by the convention in a body, as may be decided.

The meeting that was held in Honolulu in August, 1924, was of great interest and value to all who attended. The Havana meeting, with the larger attendance that is expected, promises to be a most exceptional convention for those interested in the technical problems of sugar production.

Thirteen sugar producing regions were represented at Honolulu, namely: Australia, Fiji, Formosa, Japan, Philippine Islands, India, Java, Chile, Mexico, Porto Rico, Cuba, Continental United States and the Hawaiian Islands.

In all probability a much wider representation will be had at the Havana meeting, as the membership of the Society now includes all the important cane sugar sections of the world.

Among the subjects to be discussed are:

- Insect pests of sugar cane.
- Diseases of the sugar cane plant.
- Sugar cane varieties and related problems of seed selection and seedling propagation.
- Protective quarantine measures.
- Field practices such as cultivation, fertilization, tillage, &c.
- The operation and chemical control of the cane sugar factory.

Technical papers presented at the meetings will be limited to approximate brevity so as to allow adequate opportunity for an exchange of views by the representatives of the various sugar producing sections. The plan followed so successfully at Honolulu, of having the topics discussed under the leadership of a qualified specialist, is thought to be a desirable one to use again.

All inquiries regarding hotel accommodations or similar matters may be addressed to Mr. E. L. Anderson, Secretary of the Cuba Sugar Club, Apartado 1973, Havana, Cuba. Mr. Anderson has kindly offered to assist in particulars of this kind."

REVIEW.

GENETICS IN PLANT AND ANIMAL IMPROVEMENT —Donald Forsha Jones, Chapman and Hall, Ltd., London, 1925. Price 20s. net.

Dr. D. F. Jones is well-known for his excellent work on the genetics of maize, and he has now written a text book of genetics, intended for the beginning student and for the general reader. The book is well written in parts but cannot be whole heartedly praised. The tedious and circumlocutory style of writing is perhaps its worst feature and one sometimes comes across phrases which positively lacerate. Note such a phrase as this: "in such a way as to remove doubt as to the accuracy of the conclusion;" and this: "to advance real achievement." It may be supposed that the meaning of the latter phrase is "to achieve real advancement."

The authors own investigations on maize have been drawn on to a greater extent than is permissible in a work designed primarily as a first course in genetics. The book is consequently not well balanced, and this is reflected in the list of references to literature, which contains a curiously ill-assorted selection of titles.

To treat a science as historically as possible is an almost invariable rule in text books of the exact sciences. The justification for this practice lies not only in the clearer perspective which the student obtains of the development of the science, since he sees it as a series of landmarks, but it also enables the author of a text book to place the right amount of emphasis on the work of the investigators who have made real contributions to fundamental principles. It is therefore to be regretted that the discussion on selective fertilisation on pages 375-376 contains no reference to the work of Balls in Egypt who first observed prepotency of self-pollen in cotton many years before Dr. Jones' similar observations on maize. Instead of saying that the results obtained with maize have been corroborated by those obtained with cotton, it would be more correct to present the statement in the reverse form.

S. C. HARLAND

The subscription to *Tropical Agriculture* is six shillings per annum, post free, to all countries within the British Empire or seven shillings, post free, to all other countries. Subscriptions can commence at any time during the year.

COLLEGE NEWS.

Mr. Geoffrey Evans, C.I.E., one of the senior Scientific Officers of the Empire Cotton Growing Corporation, arrived in Trinidad on 25th September for the purpose of relieving Dr. Leake, who will shortly be going on leave on account of health reasons.

Mr. Evans, an M.A., of Cambridge, with honours in the Natural Science Tripos and the University Diploma of Agriculture, has had a long and distinguished career in tropical agriculture. Before the war, he was Deputy Director of Agriculture in the Central Provinces and for a time Principal of the Nagpur Agricultural College.

During the war, he saw service in India and Mesopotamia, on the Staff of the Deputy Quartermaster-General and as Director of Agriculture to the Mesopotamia Expeditionary Force. He was mentioned in despatches. Being demobilized in 1919, he was allowed to retain the rank of Lieutenant-Colonel.

Since the war, Mr. Evans has served for a short time in Burma, where he was placed on special duty in connection with the reorganisation of the Agricultural Department in that Province. He then served in Bengal and was Director of Agriculture in charge of that Department for nearly three years. On retiring from Bengal in the autumn of 1922. Mr. Evans joined the Empire Cotton Growing Corporation and has spent the last three years in Queensland, his services being placed on loan with the State Agricultural Department organizing cotton growing. During this period he, in addition, visited Fiji and also the Mandated Territories of Papua and New Guinea on behalf of the Commonwealth Government of Australia, for the purpose of reporting and advising on the reorganization of the Agricultural Department with a view to the possibilities of extending cotton growing.

Professor E. E. Cheesman, B.Sc., A.R.C.S., Professor of Botany and Plant Breeding, returned to Trinidad by the s.s. *Cavina* on 25th September. Professor Cheesman who for the past three years has held the position of Lecturer in Botany in the College, was promoted to be Professor on the resignation of Dr. S. C. Harland, who has joined the Empire Cotton Growing Corporation's Research Station, as Geneticist.

Mr. H. H. Croucher, B.Sc. (Lond.) the newly appointed lecturer in Chemistry arrived from England by the s s. *Inanda* on the 25th September.

Mr. A. H. McKinstry who received the Diploma of the College in 1925, has left Trinidad to take up an appointment as Assistant for the Plant Breeder, at the Empire Cotton Growing Corporation's Plant Breeding Station at Gatooma, Southern Rhodesia. During the past year Mr. McKinstry has been employed as Field Observer under the Froghopper Committee, Trinidad.

Mr. H. D. Huggins, who received the Diploma of the College in 1926, is employed at the Sugar Planters' Experiment Station, British Guiana.

Fourteen Post-Graduate Students holding Colonial Agricultural Scholarships under the Colonial Office have been admitted to the College for the Session 1926-27. For the same period there have been enrolled ten Post-Graduate Students holding Scholarships under the Empire Cotton Growing Corporation. In the Diploma Course, six students have been admitted to the 1st Year; five to the 2nd Year, and three to the 3rd Year. Two students are taking a 4th Year, after finishing their Diploma Course, and, in addition, there are two advanced students sent out by the Government of the Gold Coast, and three students taking a one year course independently. This makes a total of forty-four students enrolled during the first week of the College Session.

The following Students are taking the Diploma Course :

1st Year :—Mr. H. L. Grogan (Barbados); Mr. A. E. W. Sheffield (England); Messrs. V. O. Ribeiro, C. C. Reece and G. O. Lee (Trinidad); and Mr. R. Hanomansingh (British Guiana).

2nd Year :—Mr. F. McG. Bain (Trinidad); Messrs. L. S. Birkett and G. E. L. Spencer (Barbados); Mr. A. C. G. Palmer (St. Lucia); and Mr. M. Aspiazu (Ecuador).

3rd Year :—Mr. J. A. Potter (Trinidad); Mr. J. A. MacDonald (Antigua); and Mr. R. M. Steven (British Guiana).

4th Year :—Mr. J. G. Davies (England); and Mr. H. B. Springer (Barbados). For Sugar Technology.

The Colonial Office Students are as follows :—

Mr. J. A. Craig. (West of Scotland Agr. Col.)
Mr. A. de K. Frampton. (Seale Hayne Agr. Col.)
Mr. K. T. Hartley, B.A. (Oxford University.)
Mr. C. Harvey, B.Sc., Agr. (Transvaal Uni. Col.)
Mr. R. G. Heath B.Sc., Agr. (Reading Uni. Col.)
Mr. W. V. Harris, B. Sc., Agr. (Armstrong Col.)
Mr. J. L. B. Kincaid, B.Sc., Agr. (Edin. Uni.)
Mr. E. F. Martin. (Harper Adams Agr. Col.)
Mr. H. Musk. (S. E. Agr. Col. Wye.)
Mr. C. L. Newman, B.Sc., Agr. (S.E. Agricultural College, Wye.)
Mr. C. O. Oates. (Seale Hayne Agr. Col.)
Mr. J. G. Reynard, B.Sc., Agr. (Aberdeen Uni.)
Mr. D. T. Rutter, B.Sc., Agr. (Reading Uni. Col.)
Mr. O. L. Thomas, B.Sc. (Uni. Col., South Wales.)

The Empire Cotton Growing Corporation Students are as follows :—

Mr. D. W. H. Baker, B.Sc., Agr. (S.E. Agricultural College, Wye.)
Mr. P. A. Bowmaker, B.Sc., Agr. (S.E. Agricultural College, Wye.)
Mr. W. P. K. Findlay, D.I.C., B.Sc. (Imperial College of Science and Technology.)

Mr. M. Greenwood, B.Sc. (Manchester Univer.)
Mr. O. V. S. Heath, A.R.C.S. (Imperial College of Science and Technology.)
Mr. D. MacDonald, B.Sc., Agr. (Aberdeen Uni.)
Mr. J. S. Moerdyk, B.Sc., Agr. (Transvaal University College.)
Mr. V. F. O. Olivier, B.Sc. (School of Mines, Johannesburg, and Universities of Kentucky and North Carolina.)
Mr. L. H. A. Stone, B.Sc. (Imperial College of Science and Technology.)
Mr. T. L. Williams, B.A. (St. John's College, Johannesburg and Cambridge University.)

The following members of the Gold Coast Agricultural College are taking a Post-Graduate course :—

Mr. H. K. Hewison, Superintendent of Agriculture, Ashanti.
Mr. J. E. Symond, Superintendent of the Sisal Plantation Accra.

The following special Students are also taking courses :—

Mr. M. Afzal, B.Sc. Agr. (Punjab Agricultural College.)
Mr. L. G. Bentall, B.A. (Cambridge University.)
Mr. S. J. F. Dias. (St. Thomas' College, Ceylon, and S.E. Agricultural College, Wye.)

JUTE CULTIVATION IN TRINIDAD.

[*In view of the interest which is now being taken in the possibility of Jute as an alternative crop in Trinidad, the following note by Mr. G. Evans is published. Results of the preliminary trials will follow in a later issue.*]—ED.

Soils.—A free working loam is the best soil but heavier silt soils can be successfully utilized provided efficient cultivation is given. Red laterite soils are not usually considered favourable.

Manures.—The crop responds well to manuring and a light dressing of pen manure will give satisfactory results. There is evidence to prove that jute also responds to potash and if there is any suspicion of a potash deficiency in the soil a light dressing of 60 or 70 lb. of nitrate or sulphate of potash or kainit will be beneficial as it seems to enable the crop to resist more successfully such diseases as Rhizoctonia or " leaf spot."

Preliminary cultivation.—This must be well done. Two or three preliminary ploughings and harrowings should be given in order to prepare a good seed bed and a fine tilth. The latter especially is essential, as the seed is small ; and, unless a fine tilth is obtained, it is impossible to obtain the even stand so essential to the final production of a good crop of fibre. In Bengal preparation of the land for planting usually commences in the dry weather about two months before planting.

Seed rate and spacing.—The seed is usually mixed with two or three times its bulk of dry earth or sand in order to secure volume and is broadcasted. Experiments have also been made with drilling the seed in rows 9 inches apart. When the young plants are 3 or 4 inches high, the plot is weeded and the plants thinned out to 3 to 6 inches apart. The wider spacing results in bigger plants, but these have a coarser and inferior fibre.

After cultivation.—The critical period is the first month after planting, as growth is at first slow. At least two hand weedings should be given both with a view to eradicating weeds which enter into competition with the young jute seedlings and also in giving a surface mulch. The effect of one such weeding has given remarkable results on the late sown college plots. The young plants were at a standstill, but as a result of one weeding put on a growth of 14 to 16 inches in the next week. Once the plants are 2 feet high they will make their own stand and keep above the weeds.

Varieties.—There are two species. Corchorus olitorius, a long podded kind, and C. capsularis in which, as the name implies, the seed is carried in a round capsule. The former is grown mainly in Eastern Bengal, where the whole area goes under flood water two months after planting. The latter is grown on land not liable to inundation in West Bengal and will probably prove to be best suited to Trinidad conditions. At present two types of each species are under trial.

Time of planting.—This has still to be determined for Trinidad. It appears probable, however, that this year, owing to late arrival of the seed, the trial plantings on 10th August and 5th September were too late—the former plot has already started flowering and branching at about 5 feet in height. It is likely, therefore, that, if planting be carried out at the beginning of the wet season in June or July, the plant will make more growth and hence give a longer fibre before it commences branching and flowering. This, however, is a matter for future experiment.

Retting and harvesting.—The best quality fibre is obtained when the plants are cut before the seed is ripe. The plants are cut as close to the ground level as possible, tied into bunches of about 100 and placed in a pit or pool of water and kept down below the surface by weights of stone or logs of wood. The retting process, which loosens the fibre from the pith and disintegrates the gums and resins from the bark, takes anything from 7 to 10 days, depending on the temperature and will have to be worked out for Trinidad conditions. When the retting process is complete the fibre strips off the stem as a clean ribbon. If over retted the fibre is weakened and loses value.

Yields.—It is impossible to say at this stage what the yields are likely to be, as experiments on a very small scale only have so far been conducted in Trinidad. If planted under the proper conditions at the right time and if a suitable variety is used, there appear no reasons why just as good yields as in Western Bengal should not be obtained. In that part of the world a fair average would be about 3 bales, or 1,200 lb., of clean fibre per acre. The price at present is somewhere about £30 to £31 per ton in London.